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A. Gravouil, Y. Renard and A. Combescure

LAMINATE IN SITU STRENGTH IN COHESIVE ANALYSIS: INPUT OR OUTPUT?

F.P. van der Meer
Delft University of Technology, Faculty of Civil Engineering and Geosciences,
PO Box 5048, 2600 GA, Delft, The Netherlands,
f.p.vandermeer@tudelft.nl

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ABSTRACT

Usage of XFEM has improved the fidelity of progressive analysis of laminated composite structures, because it allows for direct insertion of matrix cracks in directions that are independent of the mesh orientation [1]. In this approach, each ply is modeled with a layer of elements and cohesive XFEM cracks are inserted through the thickness of the ply where the transverse stress exceeds the strength. The crack growth direction is linked to the direction of the fibers to obtain the straight cracks that are typical for composite laminates. Because the cracks are modeled as cohesive cracks, two fundamental material parameters are required: the strength and the fracture toughness.

A widespread concept in composite material science is that of the *in situ* strength of the ply, which is defined as the stress level in a transverse ply *embedded in a laminate* for which cracks appear. It is known for a fact that this in situ strength depends on the ply thickness. This in situ effect has been explained from linear elastic fracture mechanics, where the thickness dependence is also found for the energy release rate [2].

The presented research deals with the question how the in situ ply strength is related to the input strength for the cohesive law in laminate failure analysis. It is shown that the in situ strength can be output of cohesive analysis, even with only a single layer of elements per ply [3]. The strength which serves as input in the cohesive model is not the same thing as the (in situ) strength that is defined as the stress level at which cracks appear.

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